Metric Mania Name_____

Conversion Challenge

Write the correct abbreviation for each metric unit.

1) Kilogram Kg
2) Meter m
3) Gram g
4) Milliliter mL
5) Millimeter mm
6) Liter L
7) Kilometer Km
8) Centimeter Cm
9) Milligram mg

Try these conversions, using the ladder method.

1) 2000 mg = 2 g
2) 104 km = 104000 m
3) 480 cm = 4.8 m
4) 5.6 kg = 5600 g
5) 8 mm = 0.8 cm
6) 5 L = 5000 mL
7) 198 g = 0.198 kg
8) 75 mL = 0.075 L
9) 50 cm = 0.5 m
10) 5.6 m = 560 cm
11) 16 cm = 160 mm
12) 2500 m = 2.5 km
13) 65 g = 65000 mg
14) 6.3 cm = 63 mm
15) 120 mg = 0.12 g

Compare using <, >, or =.

16) 63 cm (<) 6 m
17) 5 g (>) 508 mg
18) 1,500 mL (=) 1.5 L
19) 536 cm (=) 53.6 dm
20) 43 mg (<) 5 g
21) 3.6 m (>) 36 cm

Density Problems

1. Mercury metal is poured into a graduated cylinder that holds exactly 22.5 mL. The mercury used to fill the cylinder weighs 306.0 g. From this information, calculate the density of mercury.

$D = \frac{m}{V}$ $\frac{306.0\,g}{22.5\,mL} = 13.6\ g/mL$ (3 SF)

2. What is the weight of the ethanol that exactly fills a 200.0 mL container? (The density of ethanol is 0.789 g/mL)

$D = \frac{m}{V}$ $m = DV$ $\frac{0.789\,g}{mL} \times 200.0\,mL = 157.8 \rightarrow 158\,g$ 3SF

3. What volume of silver metal will weigh exactly 2500.0 g. The density of silver is 10.5 g/cm^3

$D = \frac{m}{V}$ $V = \frac{m}{D}$ $2500.0\,g \times \frac{cm^3}{10.5\,g} = 238.095\ldots \rightarrow 238\,cm^3$

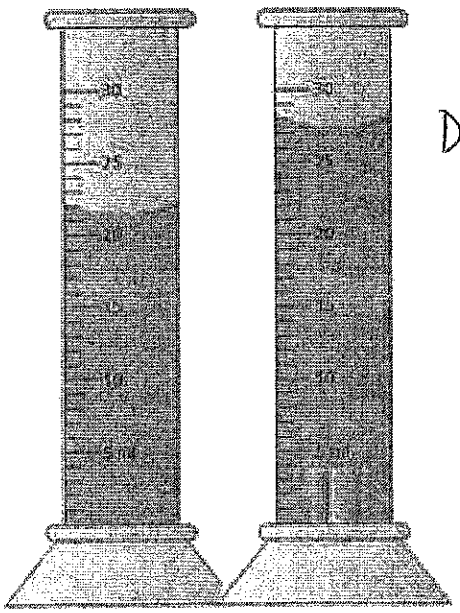
4. 4. A rectangular block of metal weighs 1896 g. The dimensions of the block are 8.4 cm by 5.5 cm by 4.6 cm.

   a. From this data, calculate the density of the metal in g/mL? $1\,cm^3 = 1\,mL$

$D = \frac{m}{V}$ $\frac{1896\,g}{8.4 \times 5.5 \times 4.6\,cm^3} = 8.9\,g/cm^3$

$V = L \times W \times H$ b. Examine the table below and determine the identity of the metal.

5. Examine the picture below to evaluate the volume of a unknown piece of metal that has a mass of the 43.2 g.



   a. From this data, calculate the density of the metal in g/mL?

$D = \frac{m}{V}$ $\frac{43.2\,g}{(27.5 - 21.5)} = \frac{43.2\,g}{6.0\,mL} = 7.2\,g/mL$

   b. Examine the table below and determine the identity of the metal.

Cr (Chromium)

Element	density (g /cm^3)
Ti	4.50
Cr	7.20
Fe	7.86
Co	8.90
Ni	8.90
Cu	8.92
Zn	7.14

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MATH HANDBOOK TRANSPARENCY MASTER 1

Scientific Notation

Use with Appendix B, Scientific Notation

Scientists need to express small measurements, such as the mass of the proton at the center of a hydrogen atom (0.000 000 000 000 000 000 000 001 673 kg), and large measurements, such as the temperature at the center of the Sun (15 000 000 K). To do this conveniently, they express the numerical values of small and large measurements in scientific notation, which has two parts.

A number in which only one digit is placed to the left of the decimal → $N \times 10^n$ ← An exponent of 10 by which the number is multiplied

Thus, the temperature of the Sun, 15 million kelvins, is written as 1.5×10^7 K in scientific notation.

Positive Exponents Express 1234.56 in scientific notation.

1234.56

Each time the decimal place is moved one place to the left,

$1234.56 \times 10^0 = 123.456 \times 10^1$

$123.456 \times 10^1 = 12.3456 \times 10^2$

$12.3456 \times 10^2 = 1.234\,56 \times 10^3$

$1.234\,56 \times 10^3$

the exponent is increased by one.

Negative Exponents Express 0.006 57 in scientific notation.

0.006 57

Each time the decimal place is moved one place to the right,

$0.006\,57 \times 10^0 = 0.0657 \times 10^{-1}$

$0.0657 \times 10^{-1} = 0.657 \times 10^{-2}$

$0.657 \times 10^{-2} = 6.57 \times 10^{-3}$

6.57×10^{-3}

the exponent is decreased by one.

SCIENTIFIC NOTATION

Name _____

Scientists very often deal with very small and very large numbers, which can lead to a lot of confusion when counting zeros! We have learned to express these numbers as powers of 10.

Scientific notation takes the form of $M \times 10^n$ where $1 \leq M < 10$ and "n" represents the number of decimal places to be moved. Positive n indicates the standard form is a large number. Negative n indicates a number between zero and one.

Example 1: Convert 1,500,000 to scientific notation.
We move the decimal point so that there is only one digit to its left, a total of 6 places.

$1{,}500{,}000 = 1.5 \times 10^6$

Example 2: Convert 0.000025 to scientific notation.
For this, we move the decimal point 5 places to the right.

$0.000025 = 2.5 \times 10^{-5}$

(Note that when a number starts out less than one, the exponent is always negative.)

Convert the following to scientific notation.

1. 0.005 = 5×10^{-3}
2. 5,050 = 5.050×10^{3}
3. 0.0008 = 8×10^{-4}
4. 1,000 = 1×10^{3}
5. 1,000,000 = 1×10^{6}
6. 0.25 = 2.5×10^{-1}
7. 0.025 = 2.5×10^{-2}
8. 0.0025 = 2.5×10^{-3}
9. 500 = 5×10^{2}
10. 5,000 = 5×10^{3}

Convert the following to standard notation.

1. 1.5×10^3 = 1500
2. 1.5×10^{-3} = 0.0015
3. 3.75×10^{-2} = 0.0375
4. 3.75×10^{2} = 375
5. 2.2×10^{5} = 220000
6. 3.35×10^{-1} = 0.335
7. 1.2×10^{-4} = 0.00012
8. 1×10^{4} = 10000
9. 1×10^{-1} = 0.1
10. 4×10^{0} = 4

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MATH HANDBOOK TRANSPARENCY MASTER 2

Operations with Scientific Notation

Use with Appendix B, Operations with Scientific Notation

Addition and Subtraction

Before numbers in scientific notation can be added or subtracted, the exponents must be equal.

Not equal — Equal

$$(3.4 \times 10^2) + (4.57 \times 10^3) = (0.34 \times 10^3) + (4.57 \times 10^3)$$

The decimal is moved to the left to increase the exponent.

$$= (0.34 + 4.57) \times 10^3$$

$$= 4.91 \times 10^3$$

Multiplication

When numbers in scientific notation are multiplied, only the number is multiplied. The exponents are added.

$$(2.00 \times 10^3)(4.00 \times 10^4) = (2.00)(4.00) \times 10^{3+4}$$

$$= 8.00 \times 10^7$$

Division

When numbers in scientific notation are divided, only the number is divided. The exponents are subtracted.

$$\frac{9.60 \times 10^7}{1.60 \times 10^4} = \frac{9.60}{1.60} \times 10^{7-4}$$

$$= 6.00 \times 10^3$$

Name _____ Date _____ Class _____

MATH HANDBOOK TRANSPARENCY WORKSHEET 2

Operations with Scientific Notation

Use with Appendix B, Operations with Scientific Notation

1. Perform the following operations and express the answers in scientific notation.

a. $(1.2 \times 10^5) + (5.35 \times 10^6)$ $5.47 \times 10^6 \rightarrow 5.5 \times 10^6$

b. $(6.91 \times 10^{-2}) + (2.4 \times 10^{-3})$ $7.15 \times 10^{-2} \rightarrow 7.2 \times 10^{-2}$ (remember -3 is less than -2)

c. $(9.70 \times 10^6) + (8.3 \times 10^5)$ $10.53 \times 10^6 \rightarrow 10.5 \times 10^6$

d. $(3.67 \times 10^2) - (1.6 \times 10^1)$ $3.51 \times 10^2 \rightarrow 3.5 \times 10^2$

e. $(8.41 \times 10^{-5}) - (7.9 \times 10^{-6})$ $7.62 \times 10^{-5} \rightarrow 7.6 \times 10^{-5}$

f. $(1.33 \times 10^5) - (4.9 \times 10^4)$ $0.84 \times 10^{-5} \rightarrow 8.4 \times 10^{-6}$

2. Perform the following operations and express the answers in scientific notation.

a. $(4.3 \times 10^8) \times (2.0 \times 10^6)$ 8.6×10^{14}

b. $(6.0 \times 10^3) \times (1.5 \times 10^{-2})$ 9.0×10^1

c. $(1.5 \times 10^{-2}) \times (8.0 \times 10^{-1})$ $12 \times 10^{-3} \rightarrow 1.2 \times 10^{-4}$

d. $\dfrac{7.8 \times 10^3}{1.2 \times 10^4}$ 6.5×10^{-1}

e. $\dfrac{8.1 \times 10^{-2}}{9.0 \times 10^2}$ $0.90 \times 10^{-4} \rightarrow 9.0 \times 10^{-5}$

f. $\dfrac{6.48 \times 10^5}{(2.4 \times 10^4)(1.8 \times 10^{-2})}$ 1.5×10^3

WS 1.6 Dimensional Analysis (CONVERSIONS)
This may be the most important worksheet of the semester.

1 ft = 12 in
1 mi = 5280 ft
1 lb = 16 oz
1 gal = 4 qt
1 in = 2.54 cm
1 mi = 1.61 km
1 lb = 454 g
1 L = 1.057 qt
1 m = 100 cm
1 km = 1000 m
1 kg = 1000 g
1 L = 1000 mL
1 mL = 1 cm^3

example A: 29.5 in --> ft: $29.5\,\text{in} \times \frac{1\,\text{ft}}{12\,\text{in}} = 2.46\,\text{ft}$

example B: 0.036 m --> in: $0.036\,\text{m} \times \frac{100\,\text{cm}}{1\,\text{m}} \times \frac{1\,\text{in}}{2.54\,\text{cm}} = 1.4\,\text{in}$

1) 2.45 ft --> mi $2.45\,\text{ft}\left(\frac{1\,\text{mi}}{5280\,\text{ft}}\right) = 0.000464\,\text{mi}$

2) 75.0 kg --> lb $75.0\,\text{kg}\left(\frac{2.2\,\text{lb}}{1\,\text{kg}}\right) = 165\,\text{lb}$

3) 10.0 gal --> mL $10.0\,\text{gal}\left(\frac{4\,\text{qt}}{1\,\text{gal}}\right)\left(\frac{1\,\text{L}}{1.057\,\text{qt}}\right)\left(\frac{1000\,\text{mL}}{1\,\text{L}}\right) = 37800\,\text{mL}$

4) 89 km --> in $89\,\text{km}\left(\frac{1\,\text{mi}}{1.6\,\text{km}}\right)\left(\frac{5280\,\text{ft}}{1\,\text{mi}}\right)\left(\frac{12\,\text{in}}{1\,\text{ft}}\right) = 3500000 \text{ or } 3.5\times10^{6}\,\text{in}$

example C: 5.17 lb/gal --> lb/qt: $5.17\frac{\text{lb}}{\text{gal}} \times \frac{1\,\text{gal}}{4\,\text{qt}} = 1.29\,\text{lb/qt}$

example D: 3.4 mi/hr --> km/min $3.4\frac{\text{mi}}{\text{hr}} \times \frac{1.61\,\text{km}}{1\,\text{mi}} \times \frac{1\,\text{hr}}{60\,\text{min}} = 9.1\times10^{-2}\,\text{km/min}$

5) 459 ft/sec --> mi/hr $\frac{459\,\text{ft}}{\text{sec}}\left(\frac{1\,\text{mi}}{5280\,\text{ft}}\right)\left(\frac{60\,\text{sec}}{1\,\text{min}}\right)\left(\frac{60\,\text{min}}{1\,\text{hr}}\right) = 313\,\text{mi/hr}.$

6) 2.40 g/mL --> lb/gal $\frac{2.40\,\text{g}}{\text{mL}}\left(\frac{1\,\text{lb}}{454\,\text{g}}\right)\left(\frac{1000\,\text{mL}}{1\,\text{L}}\right)\left(\frac{1\,\text{L}}{1.057\,\text{qt}}\right)\left(\frac{4\,\text{qt}}{1\,\text{gal}}\right) = 20.0\,\text{lb/gal}$

7) 32.56 km/hr --> ft/hr $\frac{32.56\,\text{km}}{1\,\text{hr}}\left(\frac{1\,\text{mi}}{1.6\,\text{km}}\right)\left(\frac{5280\,\text{ft}}{1\,\text{mi}}\right) = 286500\,\text{km/hr}$

example E: 3.9 cm^3 --> ft^3 $3.9\,\text{cm}^3 \times \left(\frac{1\,\text{in}}{2.54\,\text{cm}}\right)^3 \times \left(\frac{1\,\text{ft}}{12\,\text{in}}\right)^3 = 1.4\times10^{-4}\,\text{ft}^3$

8) 5800 mi^2 --> km^2 $5800\,\text{mi}^2\left(\frac{1.6\,\text{km}}{1\,\text{mi}}\right)^2 = 15000\,\text{km}^2$

9) 35.2 ft^2 --> cm^2 $35.2\,\text{ft}^2\left(\frac{12\,\text{in}}{1\,\text{ft}}\right)^2\left(\frac{2.54\,\text{cm}}{1\,\text{in}}\right)^2 = 32,700\,\text{cm}^2$

ANS (IRO+2): 0.000464 165 107,000 22.4 32,700 15,000 313 220. 3,500,000 20.0 37,800

UNITS (IRO+2): km^2 mL lb/gal mi ft/hr cm^2 in mi/hr lb kg lb/ft^3

HOMEWORK: SET 1

Practice Problems

Factor Label Problem Solving

Name: Key

The following equalities might be necessary in some of the problems on this worksheet.

2.54 cm = 1.00 in
454 g = 1.00 lb
1.00 Angstrom (A°) = 1 x 10^{-8} cm

3 ft = 1 yard
12 inches = 1 ft

Please SHOW ALL WORK using the factor label method!!! Do not forget units!!!!

1. How many dimes are in 56 dollars? How many pennies? (ans. = 5600 pennies)

$$\$56\left(\frac{10\text{ dimes}}{\$1}\right)\left(\frac{10\text{ pennies}}{1\text{ dime}}\right) = 5600\text{ pennies}$$ → 560 dimes

2. How many nickels are there in 6 quarters? (ans. = 30 nickels)

$$6\text{ Quarters}\left(\frac{5\text{ nickels}}{1\text{ quarter}}\right) = 30\text{ nickels}$$

Counting # with units tells sig figs

3. How many hours, minutes and seconds are in 3 weeks? (ans. = 504 hrs, 30240 min, 1814400 sec)

$$3\text{wks}\left(\frac{7\text{ days}}{1\text{ wk}}\right)\left(\frac{24\text{ hr}}{1\text{ day}}\right)\left(\frac{60\text{ min}}{1\text{ hr}}\right)\left(\frac{60\text{ sec}}{1\text{ min}}\right) = 1814400\text{ sec}$$ → 504 hrs → 30240 min

4. Convert 17 pounds to grams. (ans. = 7.7 x 10^3 g)

$$17\text{ lbs}\left(\frac{454\text{ g}}{1\text{ lb}}\right) = 7718 = 7700 = 7.7\times10^3\text{ grams}$$

5. How many centimeters are in 254 inches? (ans. = 645 cm)

$$254\text{ in}\left(\frac{2.54\text{ cm}}{1\text{ in}}\right) = 645.16 = 645\text{ cm}$$

6. 50.0 yards contain how many feet? (ans. = 150 ft)

$$50.0\text{ yd}\left(\frac{3\text{ ft}}{1\text{ yd}}\right) = 150 = 150.\text{ or } 1.50\times10^2\text{ ft.}$$

7. Convert 540 mm to kilometers. (ans. = 5.40 x 10^{-4} km)

$$540\text{ mm}\left(\frac{1\text{ m}}{1000\text{ mm}}\right)\left(\frac{1\text{ Km}}{1000\text{ m}}\right) = 5.4\times10^{-4}\text{ Km}$$

8. How many centimeters are there in 2.0 feet? (ans. = 61 cm)

$$2.0\text{ ft}\left(\frac{12\text{ in}}{1\text{ ft}}\right)\left(\frac{2.54\text{ cm}}{1\text{ in}}\right) = 60.96 = 61\text{ cm}$$

9. Convert 150 feet to Angstroms. (ans. = 4.57 x 10^{11} A°)

$$150\text{ ft}\left(\frac{12\text{ in}}{1\text{ ft}}\right)\left(\frac{2.54\text{ cm}}{1\text{ in}}\right)\left(\frac{1\text{ A}^\circ}{1\times10^{-8}\text{ cm}}\right) = 4.572\times10^{11} = 4.6\times10^{11}\text{ cm}$$

Significant Figures Practice Worksheet

How many significant figures do the following numbers have?

1) 1234 4

2) 0.023 2

3) 890 2

4) 91010 4

5) 9010.0 5

6) 1090.0010 8

7) 0.00120 3

8) 3.4×10^{4} 2

9) 9.0×10^{-3} 2

10) 9.010×10^{-2} 4

11) 0.00030 2

12) 1020010 5

13) 780. 3

14) 1000 1

15) 918.010 6

16) 0.0001 1

17) 0.00390 3

18) 8120 3

19) 7.991×10^{-10} 4

20) 72 2

Name: _____

Calculations using Significant Figures

When multiplying and dividing, limit and round to the least number of significant figures for any of the factors.

> **Example 1:** 23.0 cm x 432 cm x 19 cm = 188,784 cm^3
>
> The answer is expressed as **190,000 cm^3** since 19 cm has only two significant figures.

When adding and subtracting, limit and round your answer to the least number of places in any of the numbers that make up your answer.

> **Example 2:** 123.25 mL + 46.0 mL + 86.257 mL = 255.507 mL
>
> The answer is expressed as 255.5 mL since 46.0 mL has only one decimal place.

Directions: Perform the following operations expressing the answer in the correct number of significant figures

Least # of decimal places
3, 4, 6, 8

Least # of Sig figs
1, 2, 5, 7, 9, 10

1. 1.35 m x 2.467 m = 3.33045 → 3.33 m^2
2. 1,035 m^2 ÷ 42 m = 24.6428... → 25 m
3. 12.01 mL + 35.2 mL + 6 mL = 53.2100... → 53 mL
4. 55.46 g – 28.9 g = 26.56 → 26.6 g
5. 0.021 cm x 3.2 cm x 100.1 cm = 67.2 → 67 cm^3
6. 0.15 cm + 1.15 cm + 2.051 cm = 3.351 → 3.35 cm
7. 150 L^3 ÷ 4 L = 37.5 → 40 L^2
8. 505 kg – 450.25 kg = 54.75 → 55 kg
9. 1.252 mm x 0.115 mm x 0.012 mm = 0.00172776 → 0.0017 mm^3
10. 1.278 x 10^3 m^2 ÷ 1 42.67 x 10^2 m = 0.895773463 → 0.8958 m